WHAT IS CLAIMED IS:

1. In a synchronous machine, a rotor comprising:

a rotor core;

a super-conducting coil winding extending around at least a portion of the rotor core, said coil winding having a pair of side sections on opposite sides of said rotor core;

at least one tension rod extending between the pair of side sections of the coil winding and through said rotor;

a coil housing at each of opposite ends of said tension rod, wherein said housing wraps around said coil winding and is attached to said tension rod.

2. In a rotor as in claim 1 wherein said coil housing is a U-shaped channel.

3. In a rotor as in claim 1 wherein the rotor core is in an internal vacuum.

4. In a rotor as in claim 1 further comprising a cryogenic coupling providing cooling fluid to said coil winding, wherein said housing and tension rod are cooled by conduction from said coil winding.

5. In a rotor as in claim 1 further comprising a dowel coupling the housing to the tension rod.

6. In a rotor as in claim 1 further comprising a hollow pin coupling the housing to the tension rod.

7. In a rotor as in claim 1 further comprising a dowel coupling the housing to the tension rod, wherein said pin extends through an aperture in an end of the tension rod and through apertures in side flanges on the coil housing.

8. In a rotor as in claim 1 further comprising a pin coupling the housing to the tension rod, wherein said pin extends through an aperture in an end of the tension rod and through the coil housing, and a locking-nut securing the pin to the housing.

9. In a rotor as in claim 1 further comprising a hollow pin formed of a high strength material selected from a group of metals consisting of Inconel and titanium alloys.

10. In a rotor as in claim 1 wherein said housing is formed of a metal material selected from a group consisting of aluminum, Inconel, and titanium alloys.

11. In a rotor as in claim 1 wherein said tension rod is formed of a high-strength and non-metallic metal alloy.

12. In a rotor as in claim 1 wherein said tension rod is formed of an Inconel metal alloy.

13. In a rotor as in claim 1 wherein said tension rod extends through a longitudinal axis of the rotor.

14. In a rotor as in claim 1 wherein said tension rod extends through conduits in said rotor core.

15. In a rotor as in claim 14 wherein said tension rod is spaced from rotor walls of the conduits.

16. A method for supporting a super-conducting coil winding on a rotor core of a synchronous machine comprising the steps of:

a. extending a tension bar through a conduit in said rotor core;

b. inserting a housing over a portion of the coil;

c. attaching an end of the tension bar to the housing.

17. A method as in claim 16 further comprising inserting a second housing over a second portion of the coil and attaching the second housing to a second end of the tension bar.

18. A method as in claim 16 further comprising inserting a second housing over a second portion of the coil an attaching the second housing to a second end of the tension bar, wherein said tension bar extends through a rotational axis of the rotor core, and the first portion and second portion of the coil are on opposite sides of the rotor.

19. A method as in claim 16 further comprising attaching the end of the tension bar to the housing

by inserting a dowel pin through apertures in the end of the tension bar and housing.

20. A method as in claim 16 further comprising cryogenically cooling the coil, and cooling said housing and tension rod by heat transfer between the coil and the housing and tension rod.

21. A rotor for a synchronous machine comprising:

a rotor core having a conduit orthogonal to a longitudinal axis of the rotor;

a racetrack super-conducting (SC) coil winding in a planar racetrack shape parallel to the longitudinal axis of the rotor;

a tension rod inside the conduit of the core; and

a housing coupling the coil winding to the tension rod.

22. A rotor as in claim 21 further comprising clamps at opposite ends of the coil.

23. A rotor as in claim 21 further comprising a plurality of conduits orthogonal to the longitudinal axis of the rotor core and in a plane defined by the SC coil.

24. A rotor as in claim 21 wherein the tension rod has a flat end abutting the coil.

25. A rotor as in claim 21 further comprising a dowel pin for securing the housing to the tension rod.

26. A rotor as in claim 21 wherein the dowel is hollow.

27. A rotor as in claim 21 further comprising an insulating tube sleeve between the rotor core and the tension rod.